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UNITED STATES DEPARTMENT OF AGRICULTURE
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Bureau of Plant Industry, Soils, and
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H. T. & S. Office Report No. 169

REPORT ON A TRANSPORTATION TEST WITH APPLES UNDER HEATER SERVICE FROM YAKIMA, WASH. TO MINNEAPOLIS, CHICAGO, AND OTHER EASTERN MARKETS: A COMPARISON OF THREE TYPES OF REFRIGERATOR CARS, SIX KINDS OF CAR HEATERS AND A STUDY OF THE USE OF PAPER OVER THE FLOOR RACKS IN FAN CARS. FEBRUARY 1946

(A Summary of the Most Outstanding Results
and Observations)

By

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REPORT ON A TRANSPORTATION TEST WITH APPLES UNDER HEATER SERVICE FROM YAKIMA, WASH. TO MINNEAPOLIS, CHICAGO, AND OTHER EASTERN MARKETS: A COMPARISON OF THREE TYPES OF REFRIGERATOR CARS, SIX KINDS OF CAR HEATERS AND A STUDY OF THE USE OF PAPER OVER THE FLOOR RACKS IN FAN CARS. FEBRUARY 1946

(A summary of the most outstanding results and observations)

The principal purpose of this test was to compare the performance of different kinds of heaters designed for use in refrigerator cars. Those tested are listed in Table 3. Another object of the test was to observe the influence of circulating air in fan cars upon heater operation. Results of the January, 1946 transportation test, H. T. & S. Office Report No. 167, suggested the possible desirability of papering the floor racks in cars equipped with Preco fans, in order to equalize temperatures when using one fan and to draw heated air around the load, rather than through it, when using both fans.

An outline of heater and car operation is shown in Table 1. Characteristics of the refrigerator cars and heaters used are given in Tables 2 and 3, respectively. Eight commodity and four air temperatures at various positions in each car were taken by means of electric resistance thermometers, read from the outside of the cars. Two of the cars were equipped with Liquidometers (indicating thermometers), see page 3. The electric resistance thermometers were placed as follows in all cars:

Location of Electric Resistance Thermometers

Commodity

Bottom bunker, north side, forward end
" " " " rear end

Top bunker, centerline, forward end
" " " rear end

Top quarterlength, centerline, forward end
" " " rear end
" door "
Bottom door, north side

Air

Bottom bunker, north side, forward end
" " " " rear end
" door, centerline, door post*
" " north side

*The bottom door centerline position was selected for an air temperature near the position of the bulb of a liquidometer in the two BREX cars. Relative positions were only approximate, however, because of the cable lengths. In BREX 74699 this position was about 18 inches nearer the north side than the liquidometer bulb, and above the floor racks.

The layers in which top commodity temperatures were taken varied because of car dimensions and some differences in loading among shippers. Usually the commodity temperature at the top doorway was taken one layer lower than that at the bunkers, because of the way the cars had to be loaded. The layer in which each top commodity temperature was taken was as follows:

	Forward bunker	Quarter	Doorway	Rear quarter	Bunker
NP 92514	5th	5th	5th	6th	6th
NP 92095	6th	6th	5th	5th	5th
NP 92244	6th	5th	5th	6th	6th
ART 35033	6th	6th	5th	6th	6th
NP 92048	5th	5th	4th	5th	5th
NP 90241	6th	5th	5th	6th	6th
NP 90221	6th	5th	5th	6th	6th
NP 90187	5th	5th	5th	5th	5th
WFE 65849	6th	6th	5th	6th	6th
WFE 65532	6th	6th	5th	6th	6th
BRE 74698	6th	6th	5th	6th	6th
BRE 74699	5th	5th	4th	5th	5th

Car loading data are given in Table 4.

Outside Temperatures

The weather encountered was mild, as shown by the maximum and minimum temperatures recorded on the charts, and the following more detailed data:

Day	Time	Temperature
	P.M.	
Feb. 20	2:45	54
	4:50	56
	7:10	47
	10:00	43
Feb. 21	A.M.	
	5:00	35
	7:00	36
	11:30	42
	P.M.	
	3:00	48
	5:00	45
	6:15	44
	8:15	40
	10:00	37
	11:30	33

Day	Time	Temperature
	A.M.	
Feb. 22	6:55	33
	11:45	42
	P.M.	
	2:25	52
	3:40	52
	6:00	38
	8:50	36
	10:50	34
Feb. 23	A.M.	
	1:50	24
	3:55	24
	5:00	32
	7:20	34
	8:30	36
	10:20	39
	P.M.	
	12:40	46
	1:10	40
	2:45	52
	4:45	52
	6:45	43
	9:20	36
	11:30	31

Day	Time	Temperature
	A.M.	
Feb. 24	2:35	32
	4:30	30
	6:00	30
	8:25	34
	9:40	36
	P.M.	
	1:20	58
	3:00	59
	5:25	50
	7:35	32
	8:40	34
Feb. 25	A.M.	
	12:45	34
	6:40	27
	8:40	26
	10:25	24
	11:30	22
	P.M.	
	12:50	20
	2:45	18
	4:10	18
	5:15	16
	7:00	16
	8:00	17
	10:45	18
	A.M.	
Feb. 26	6:45	14
	10:05	17
	P.M.	
	12:30	20
	1:50	20
	3:05	22
	4:35	18
	6:45	22
	8:10	22
	11:55	19
	A.M.	
Feb. 27	7:10	10
	8:25	14
	9:05	14
	10:15	22
	11:25	26
	P.M.	
	12:01	28
	2:20	24
	7:00	24

Liquidometer Records

Cars BREX 74698 and BREX 74699 were equipped with Liquidometers. Temperature readings were taken from the Liquidometers at the same time that readings were made with electric resistance thermometers, one lead of which was fastened near the bottom Liquidometer bulb. Readings obtained with both kinds of instruments are given in Table 5.

The greatest differences between the two sets of readings were in the fan car, BREX 74698, especially after the car was in motion. In general, the Liquidometer showed higher readings than the electric resistance thermometer. Beyond Jamestown, and while the car was passing through cold weather, the bottom Liquidometer in this car indicated higher temperatures than the top one.

In BREX 74699 in which there was no forced air circulation, the two sets of readings were fairly close together throughout.

Results

The mild weather encountered during transit made it impossible to secure data pertinent to the primary objectives of the test.

The commodity temperatures in the car, taken together with the weather forecast, made it appear inadvisable to light heaters at any time. The bottom air temperature indicated by the Liquidometer in BREX 74699, however, indicated 30° F. at 10:15 a.m. February at Staples, Minn. Under the carline instructions for operation of this heater, it was, therefore, lighted at Staples and set on draft position 2. (low draft). At 7:00 p.m. at the next division point the bottom air temperature had reached 34° and the draft was set at 0 position (shut off). At N. LaCrosse the Liquidometer read 31° and the heater was relighted and again set at position 2. The temperature graphs for this car, Figure 12, show that this operation of the heater raised the average bottom fruit temperatures only 2.5° and the average top layer temperature less than 1°, which was a very satisfactory performance.

Charcoal heaters in other cars were not lighted because bottom air temperatures as determined by electric resistance thermometers did not call for that.

The pilot lights of all of the thermo-alcohol heaters kept temperatures high enough so that the main burners should not have been in operation. However, the rise in top layer temperatures, shown in the graphs for BREX 74698, Figure 11, at 8:30 p.m. February 21 and 7:00 p.m. February 26 indicate that a main burner may have been on in this car for short periods. Furthermore, the fuel consumption of the rear heater in this car was excessive in view of the fact that its pilot light was out at one point and had to be relighted. This also indicates that the main burner had been in operation at some time.

Aside from a pilot light found not burning at Pasco in NP 92514 (due to fuel supply not having been turned on at Yakima), the abovementioned pilot light failure was the only one occurring in the 17 thermo-alcohol heaters used. Nine of these were in cars having Preco fans in operation. This showed that these fans may be used without much danger of extinguishing the pilot light in alcohol heaters.

Commodity Temperatures

The temperature records of the fruit in each car are presented in graph form on the attached charts, Figures 1 to 12. The underslung charcoal heater in BREX 74699 was the only one lighted, and this was done in accordance with carline instructions for this heater. Its performance has already been discussed. Commodity temperatures in the other cars will be considered in connection with other topics.

Paper on Floor Racks in Fan Cars

The graphs in Figure 13 show top centerline fruit temperatures in the head and rear ends and at the bottom north side position in three fan cars. One had the pilot light burning in the head end, with rear fan on and paper covering the floor racks for the full width of the car. The other two fan cars had pilot lights burning at both ends and with both fans on, one having paper over the floor racks for the width of the load, leaving the floor racks uncovered between the load and the wall, while the other had no paper on the floor racks. Having both fans on and paper over the floor racks for the width of the load only, resulted in the temperature of the fruit at the bottom north side doorway being more nearly like that in the top layer than in the other cars. This method of papering the floor unquestionably caused an accelerated flow of air from the base of the side walls into the air stream entering the fans. No conclusions can be reached as to the effect of the paper on equalization of temperature between the two ends of a car in which only one fan was operating, because under prevailing weather conditions the heater was not burning.

Heat from Pilot Lights

The influence of the heat from pilot lights on fruit temperatures during mild weather is brought out by the graphs. The cars not having pilot lights (Figures 5, 8 and 12) had the most satisfactory temperatures. Great variability was observed in the amount of heat produced by different pilot lights even in heaters of the same make. The pilot light in the one heater used in NP 92514 consumed almost as much fuel, and thus produced about the same amount of heat, as the pilot lights of the 2 heaters of the same type used in NP 92244 (See Figures 1 and 3). The fruit temperatures generally indicated the greater or less heat produced by the pilot lights. This is a consideration that should be weighed both in the design of heaters and especially in their operation during mild periods. This suggests that the lighting of pilots might be postponed during periods of mild weather such as was encountered during the first 5 days of this test.

Fan Operation

From the time of departure until cars were placed for unloading in Chicago, the running time was 92 hours, 5 minutes, out of an elapsed time of 181 hours, 50 minutes. Despite having run only approximately 50 percent of the time, the fans resulted in top and bottom layers being made fairly uniform. This uniformity of temperature was most pronounced in NP 92048 in which there was no influence of pilot light heat. The temperatures in this car (See Figure 5) show that fans may be operated to good advantage during winter weather, especially if heaters are not lighted until the temperature within the car demands added protection.

Observations at Unloading

The test cars were unloaded in Minneapolis, Milwaukee, Chicago, Louisville, Detroit and New York City. It was not possible for observers to witness the unloading of all cars. Those seen arrived with little breakage, and fruit was in good condition. Some crosswise shifting was seen, boxes having worked out to come in contact with car walls, and thus would have had less protection from freezing, had cold weather been encountered. In order to provide the best conditions inside the cars for the purposes of this test, the ventilators were not opened during transit, but upon reaching Chicago all cars had ventilators opened in accordance with Carriers' Protective Service operating rules, outside temperatures being above 32° F. Cars BREX 74699 and NP 92045 were placed on team track early February 28, then reconsigned to cold storage plants, and were not unloaded until March 4. As a result of their standing with ventilators open during this long period, commodity temperatures increased 6.5° to 11° after arrival in Chicago. This was a striking demonstration of the working of an ill-advised rule. Cold fruit should not be warmed up by opening ventilators when the temperature of the outside air is higher than that of the fruit.

Acknowledgements

Besides the writers, the test party consisted of the following who accompanied the cars from Yakima and to whom thanks are expressed for their assistance:

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Perham Fruit Company
Lamb Fruit Company
Washington Fruit and Produce Company
Pacific Fruit and Produce Company
Richey and Gilbert Company

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Pacific Fruit Express Company

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M. A. Smith, U. S. Department of Agriculture, Chicago, Illinois
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Figure 1.

Car NP 92514: Fan operation, rear end. PFE Thermo-alcohol heater head end. Floor racks completely papered.

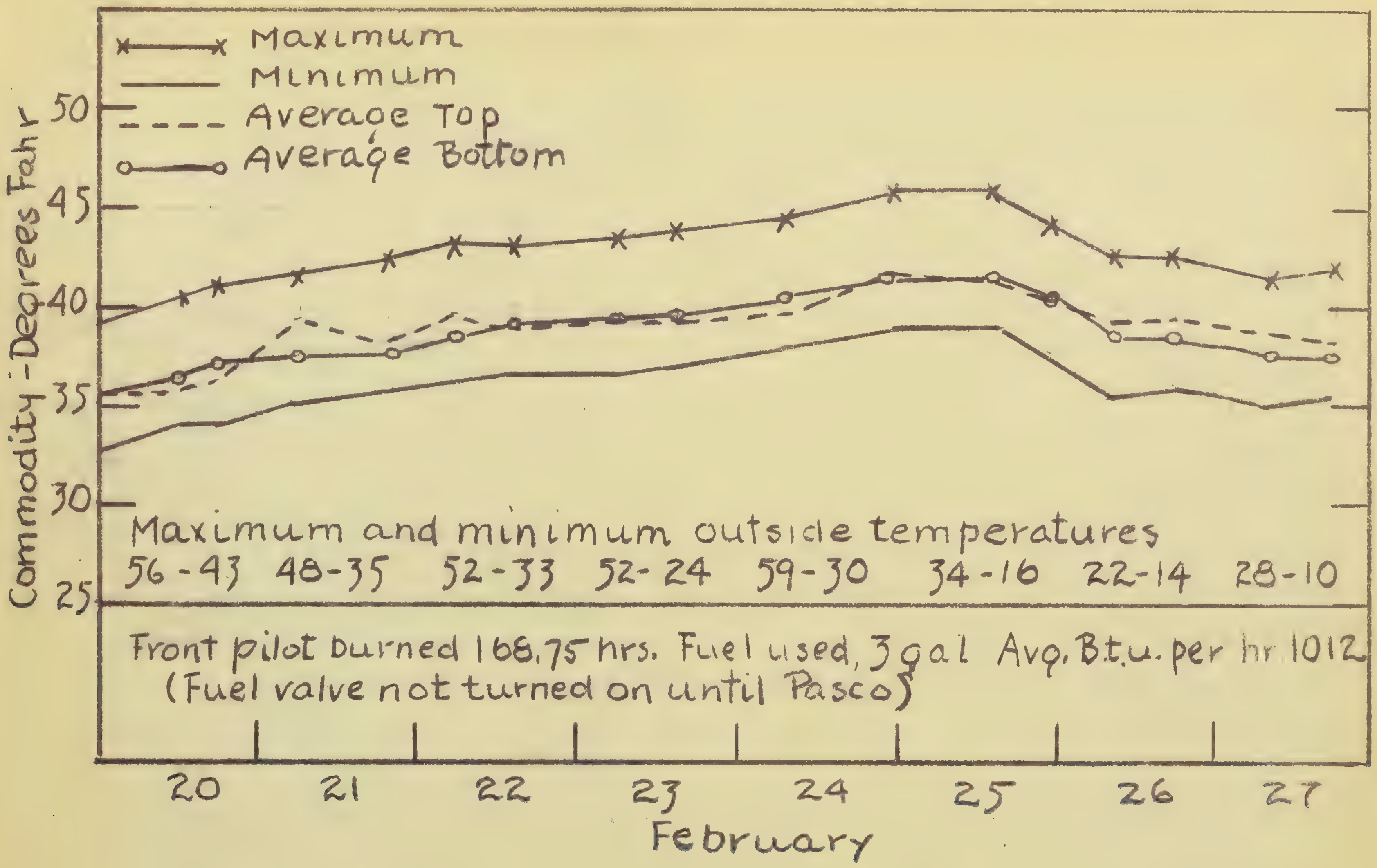
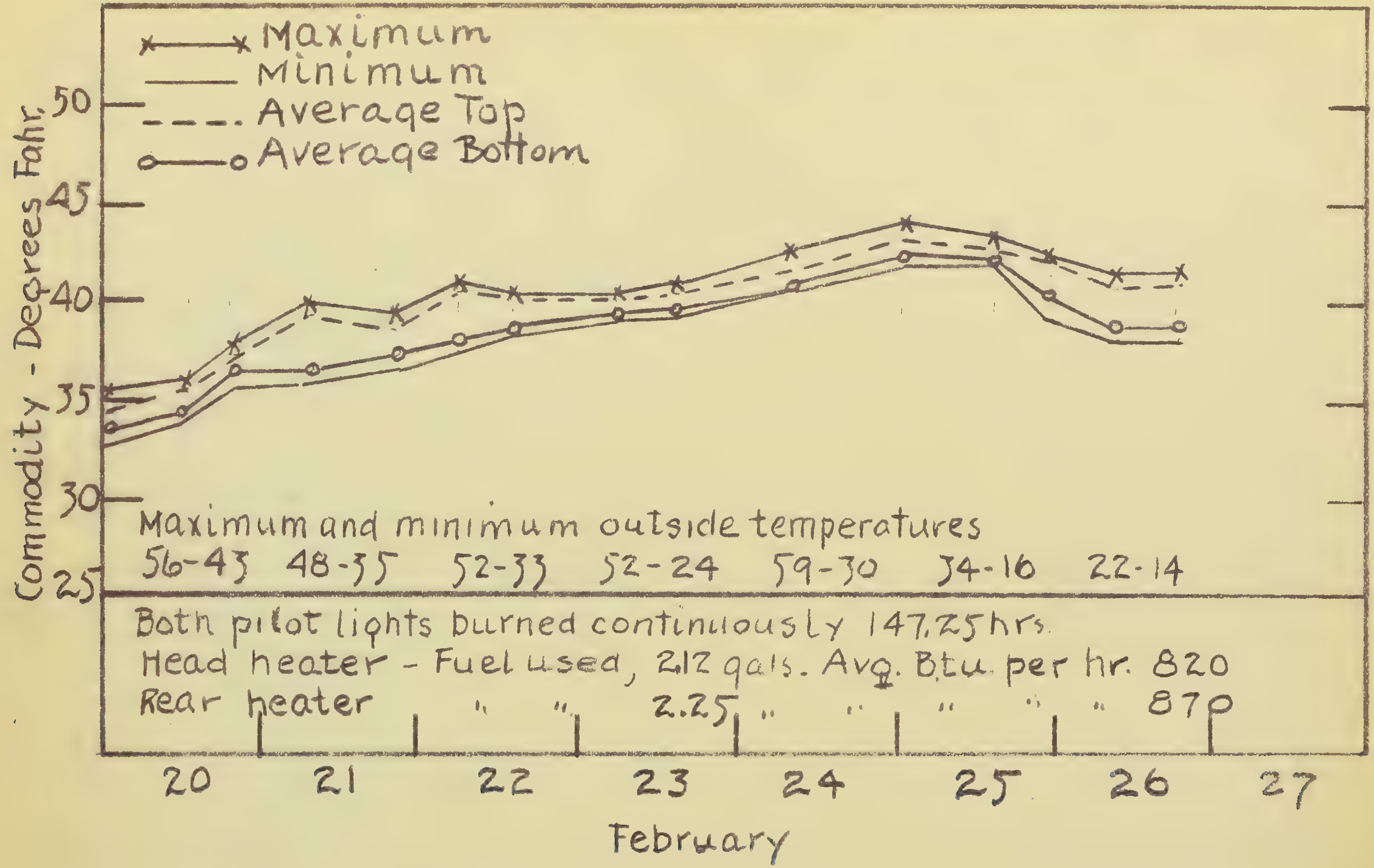


Figure 2.

Car NP 92095 Fan operation, both ends. PFE Thermo-alcohol heaters, 1 head, 1 rear. Floor racks papered load width.

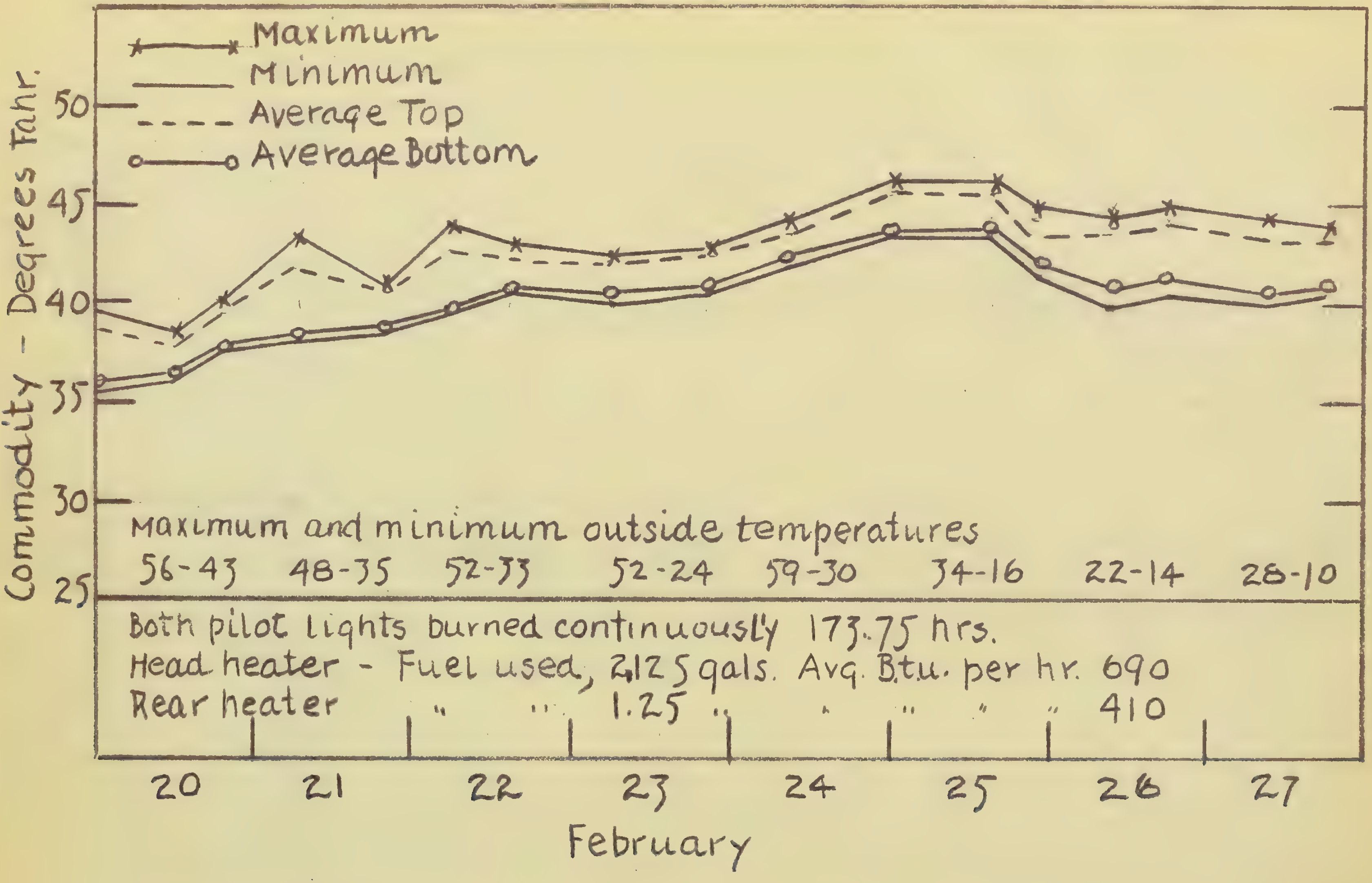


Maximum and minimum outside temperatures
56-43 48-35 52-33 52-24 59-30 34-16 22-14

Both pilot lights burned continuously 147.25 hrs.
Head heater - Fuel used, 2.12 gals. Avg. Btu. per hr. 820
Rear heater " " 2.25 " " " " " 870

Figure 3.

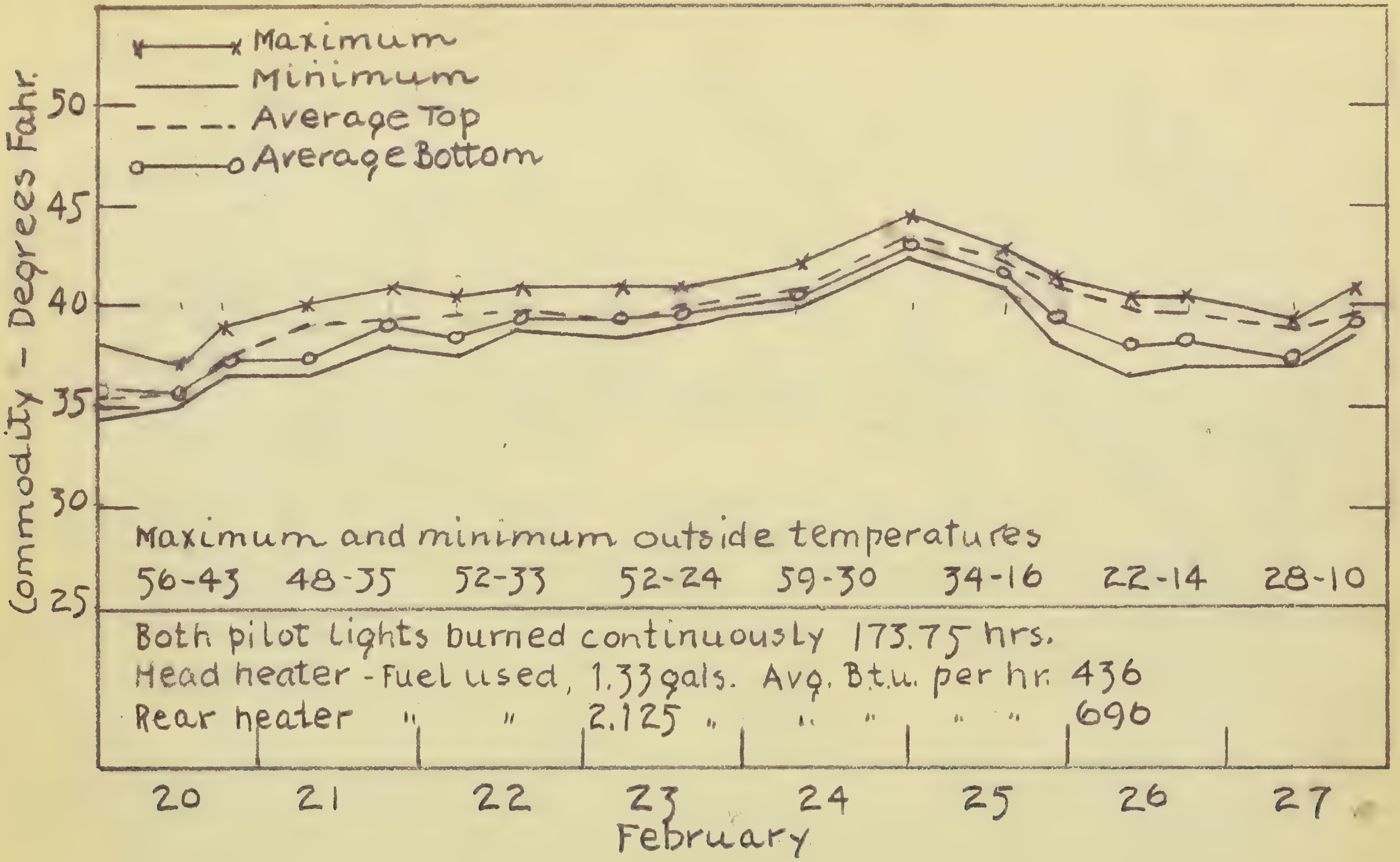
Car NP 92244 Fan operation, both ends. PFE Thermo-alcohol heaters, 1 head, 1 rear. Floor racks not papered.



Both pilot lights burned continuously 173.75 hrs.
Head heater - Fuel used, 2.125 gals. Avg. Btu. per hr. 690
Rear heater " " 1.25 " " " " 410

Figure 4.

Car ART 35033 Fan operation, both ends. Payne Thermo-alcohol heaters, 1 head, 1 rear.



Both pilot lights burned continuously 173.75 hrs.
Head heater - Fuel used, 1.33 gals. Avg. B.t.u. per hr. 436
Rear heater " " 2.125 " " " " " 696

Figure 5.

Car NP 92048 Fan operation, both ends. Thermo-charcoal heaters, 1 head, 1 rear. Inside control procedure.

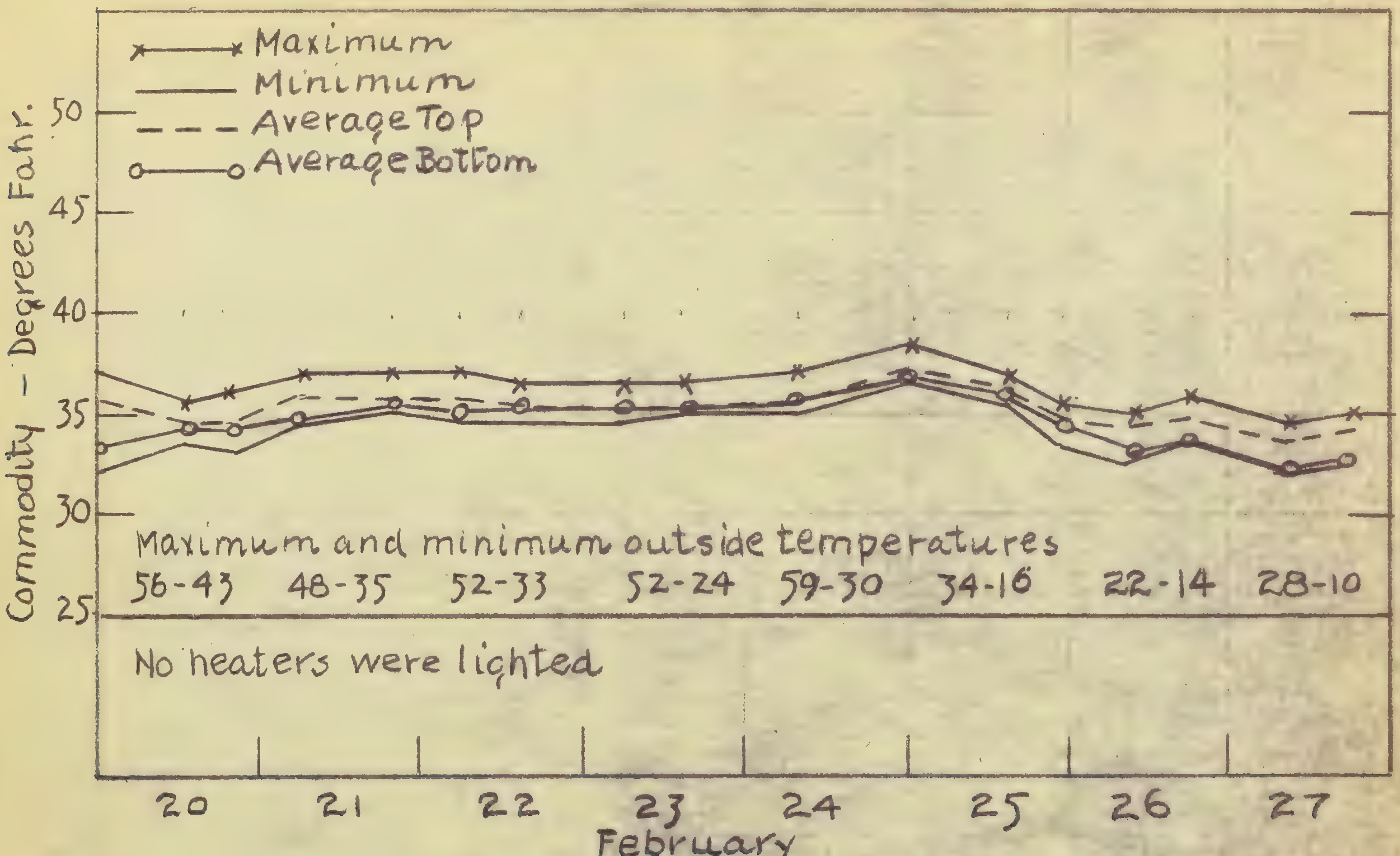
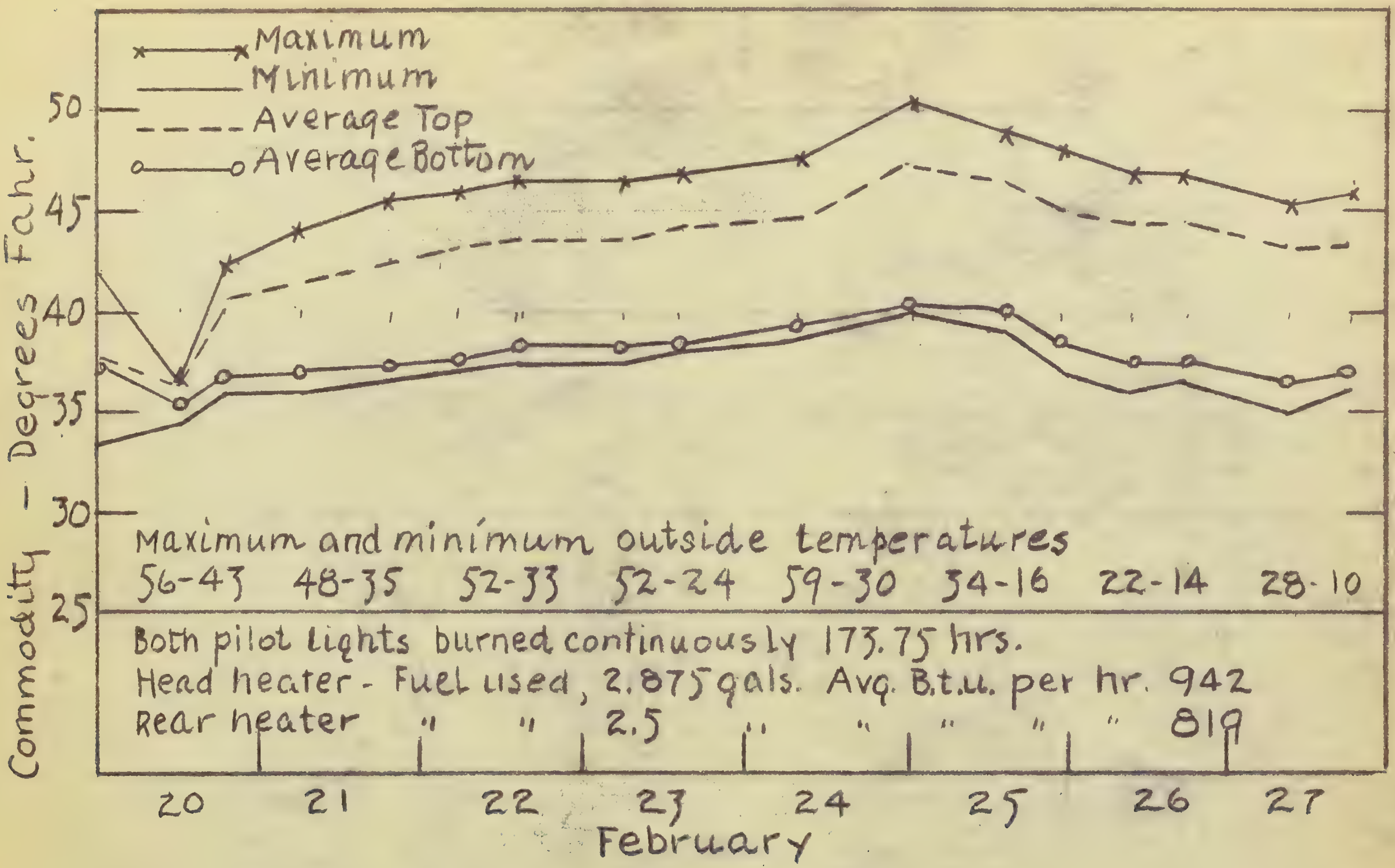


Figure 6.

Car NP90241 Without fans - PFE Thermo-alcohol heaters, 1 head, 1 rear.

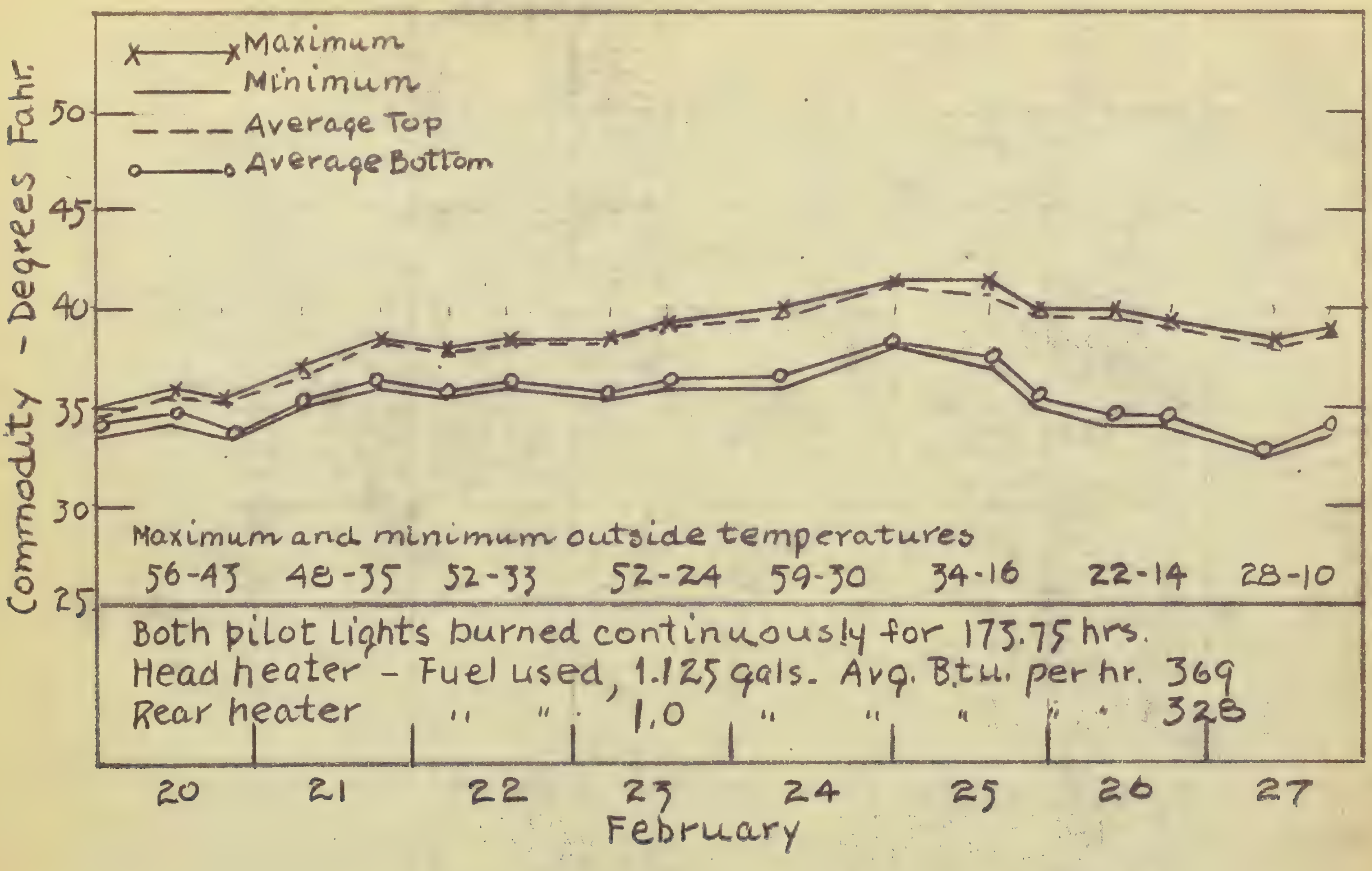


Maximum and minimum outside temperatures
56-43 48-35 52-33 52-24 59-30 34-16 22-14 28-10

Both pilot lights burned continuously 173.75 hrs.
Head heater - Fuel used, 2.875 gals. Avg. B.t.u. per hr. 942
Rear heater " " 2.5 " " " " 819

Figure 7.

Car NP 90221 Without fans. Solar Thermo-alcohol heaters, 1 head end, 1 rear end



Both pilot lights burned continuously for 173.75 hrs.
Head heater - Fuel used, 1.125 gals. Avg. B.t.u. per hr. 369
Rear heater " " 1.0 " " " " 328

Figure 8.

Car ND 90187 Without fans, Thermo-charcoal heaters, 1 head, 1 rear - Inside control procedure

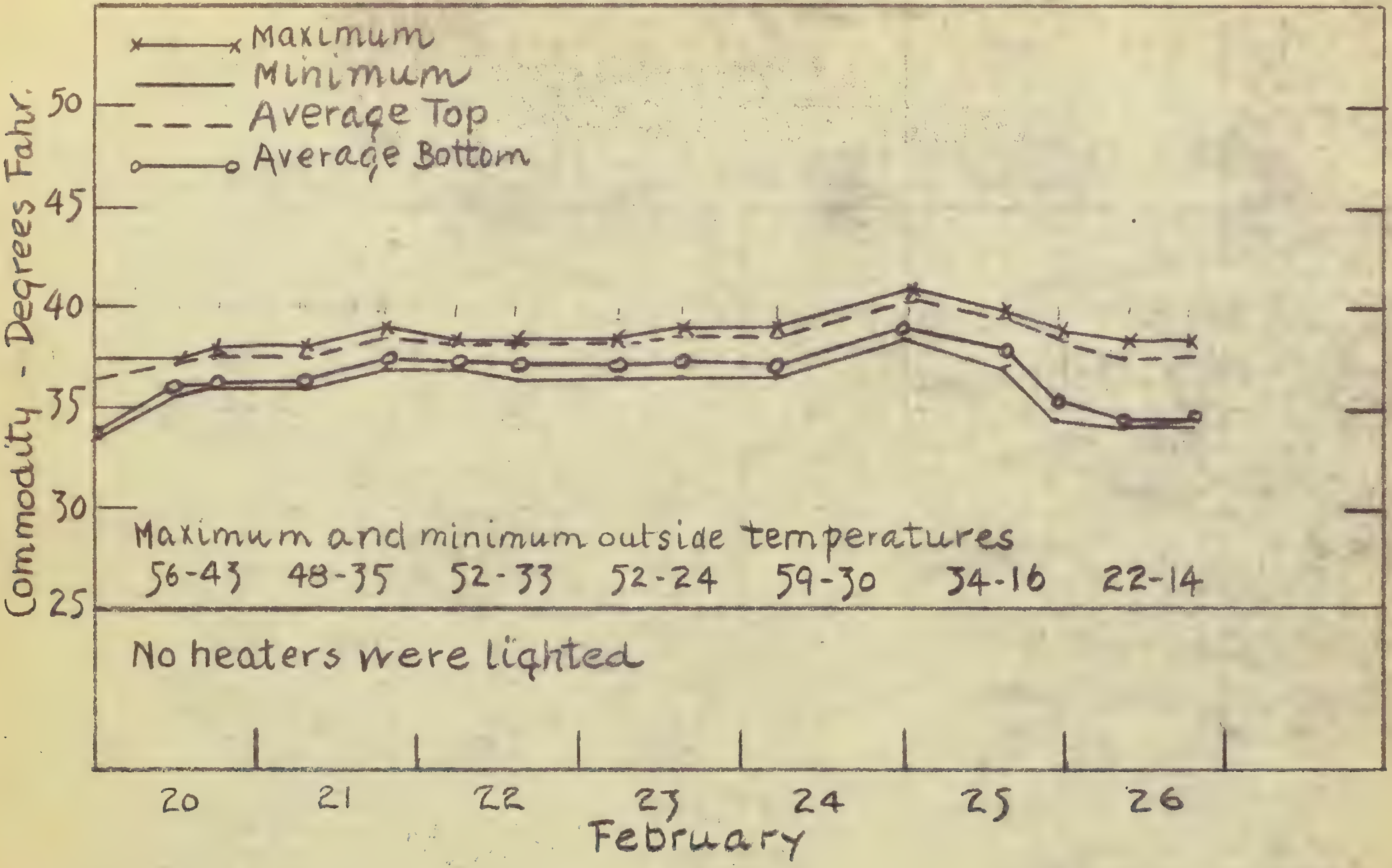
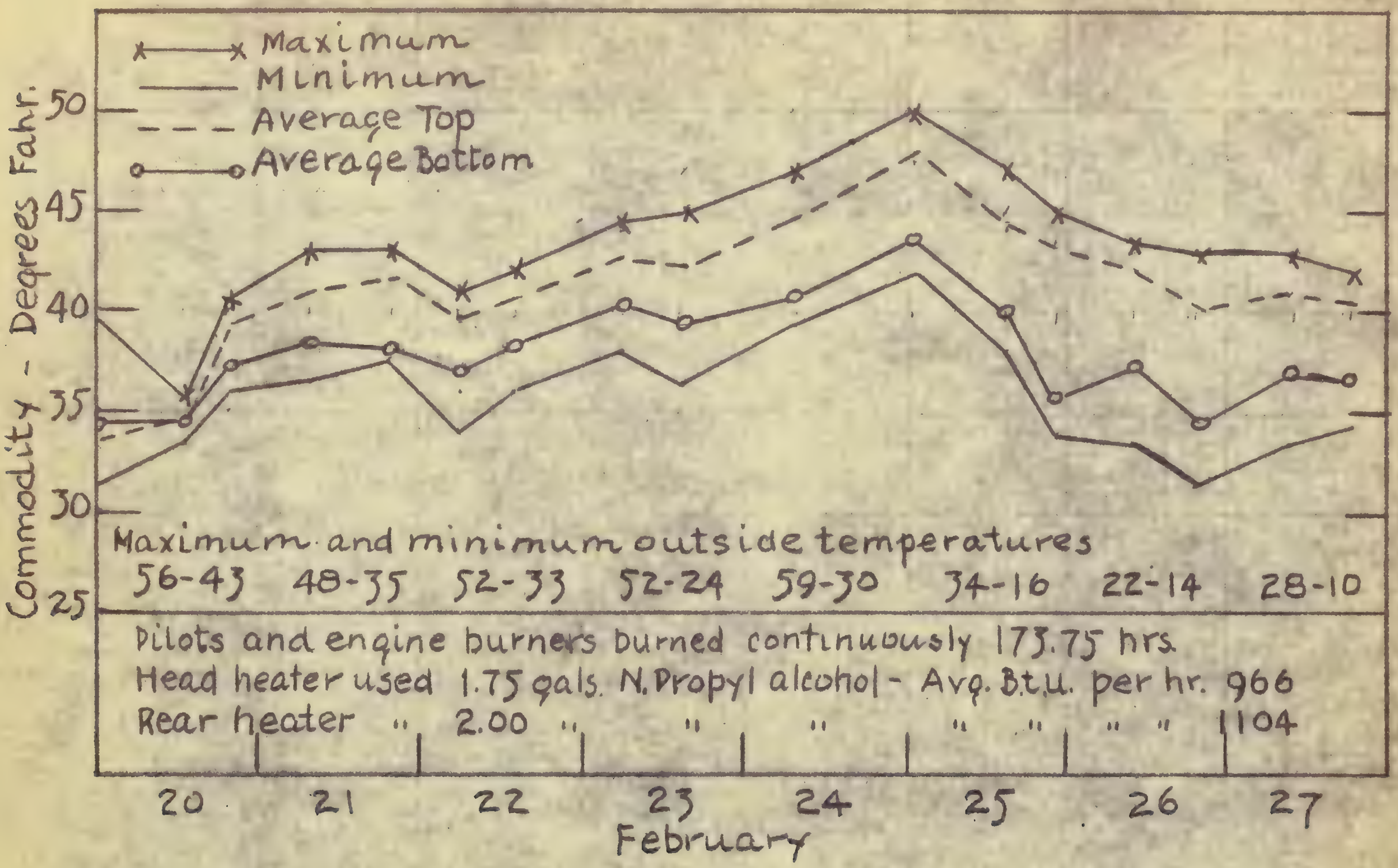


Figure 9.

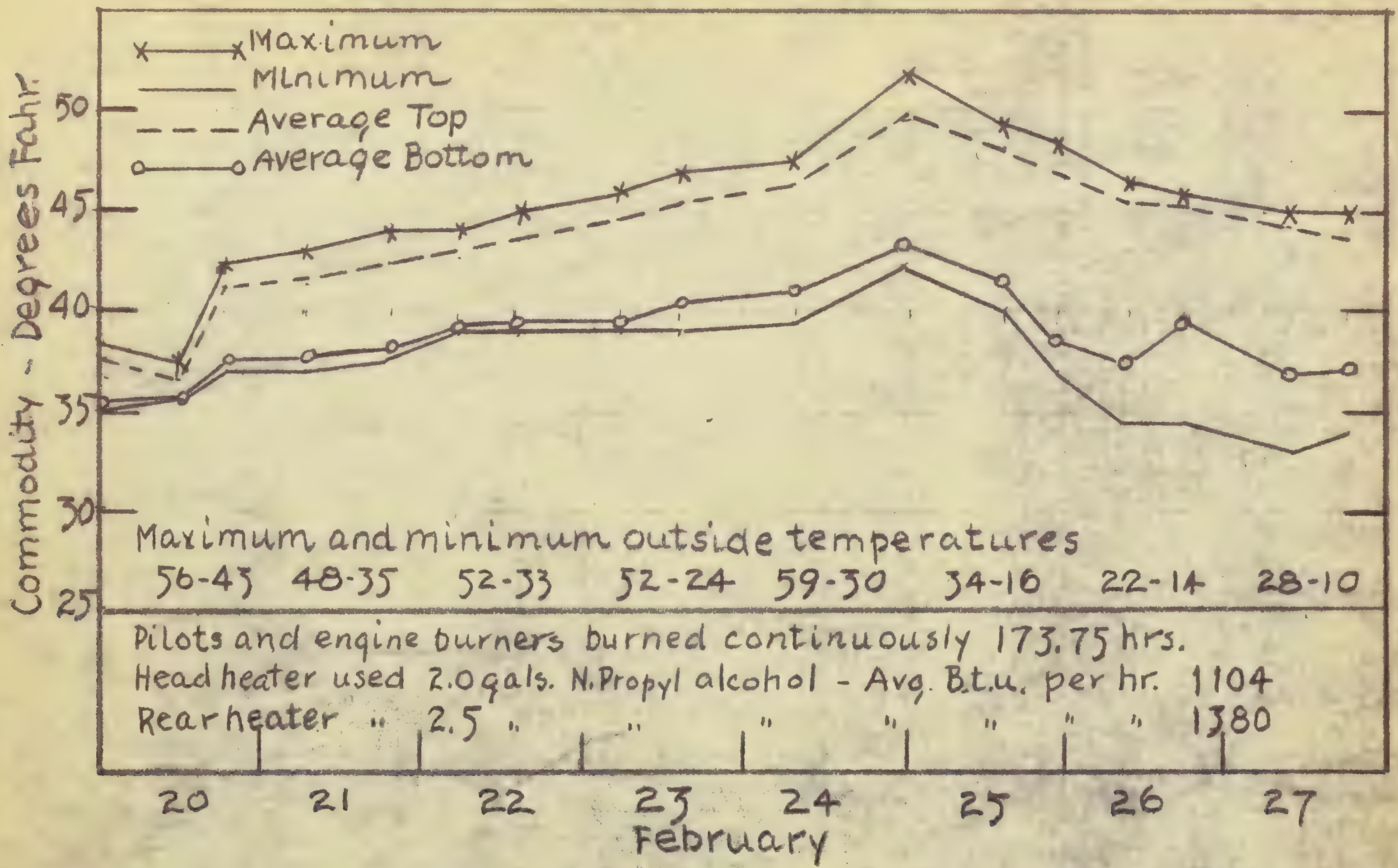
Car WFE 65849 Without fans. FGE Thermo-alcohol heaters, 1 head, 1 rear.



Pilots and engine burners burned continuously 173.75 hrs.
Head heater used 1.75 gals. N. Propyl alcohol - Avg. B.t.u. per hr. 966
Rear heater " 2.00 " " " " " " " 1104

Figure 10.

Car WFE 65332 Without fans. FGE Thermo-alcohol heaters, 1 head, 1 rear



Maximum and minimum outside temperatures

56-43 48-35 52-33 52-24 59-30 34-16 22-14 28-10

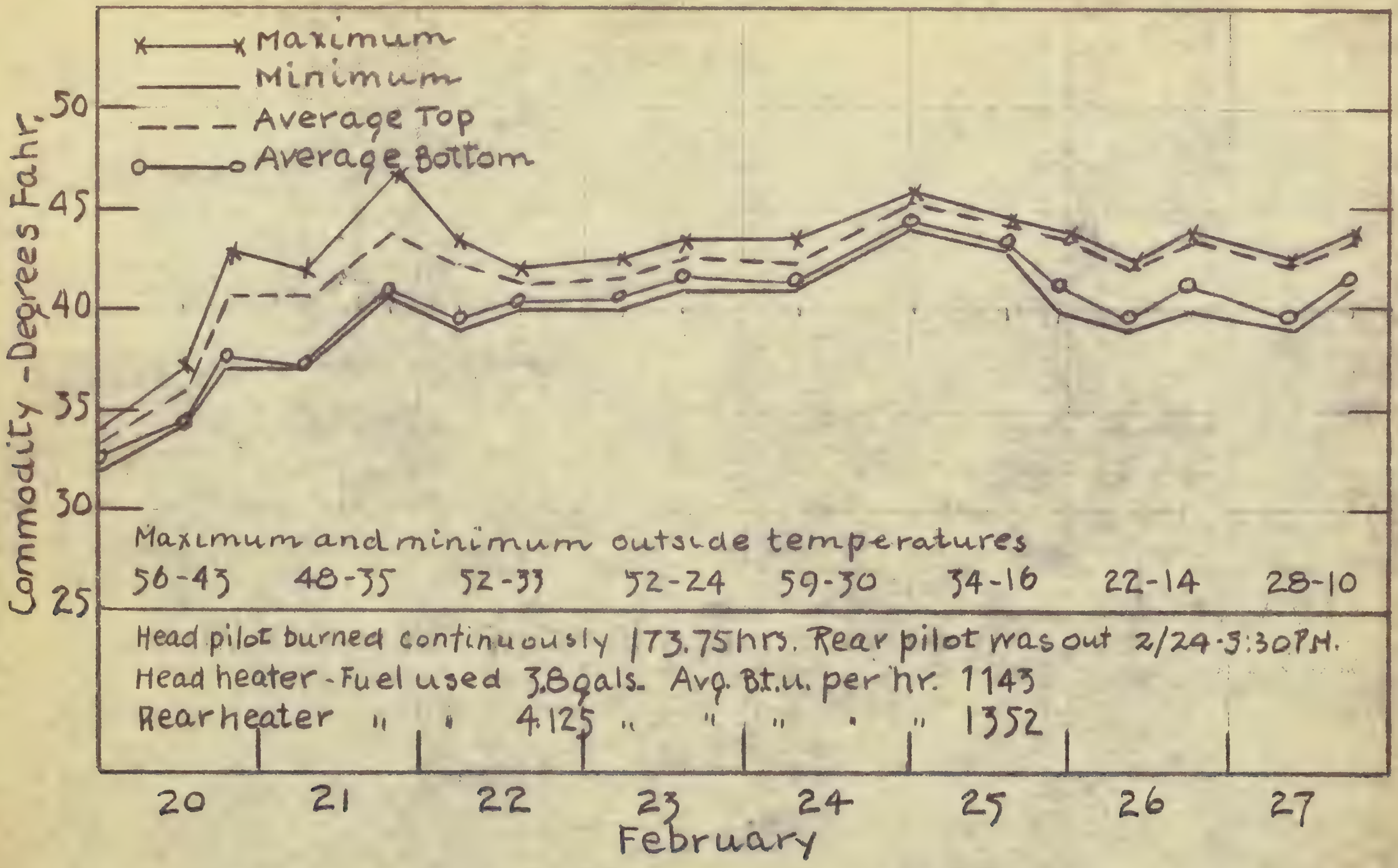
Pilots and engine burners burned continuously 173.75 hrs.

Head heater used 2.0 gals. N.Propyl alcohol - Avg. B.t.u. per hr. 1104

Rear heater " 2.5 " " " " " " " 1380

Figure 11.

Car BRE 74698 Fan operation both ends. Solar Thermo-alcohol heaters, 1 head, 1 rear.



Maximum and minimum outside temperatures

56-43 48-35 52-33 52-24 59-30 34-16 22-14 28-10

Head pilot burned continuously 173.75 hrs. Rear pilot was out 2/24-3:30 PM.
Head heater - Fuel used 3.8 gals. Avg. Bt.u. per hr. 1143
Rear heater " " 4.125 " " " " 1352

Figure 12.

Car BRE 74699 Overhead ice bunkers. Mitchell underslung charcoal heater operated under inside control procedure.

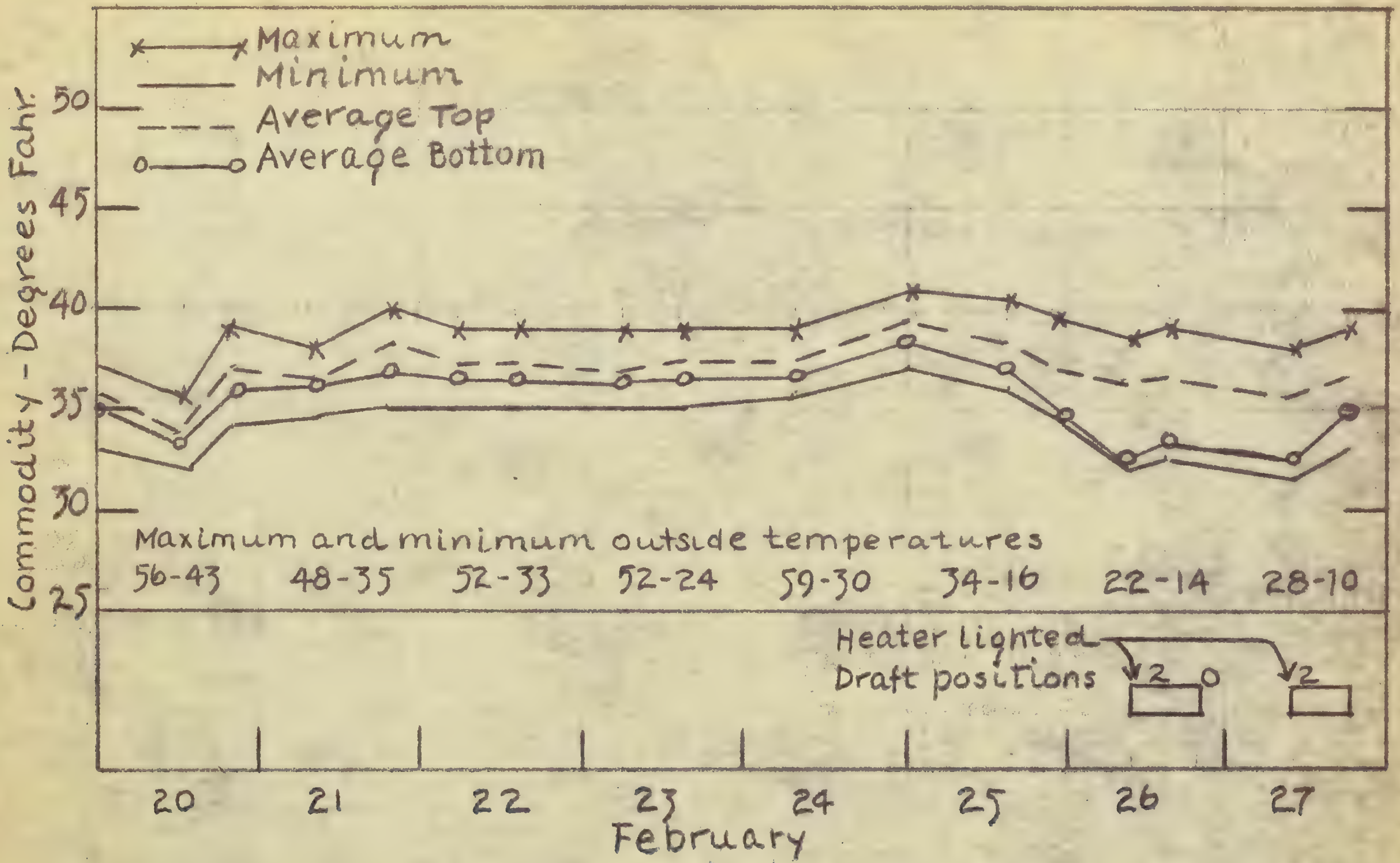


Figure 13c.

Effects of papering floor racks in fan cars.

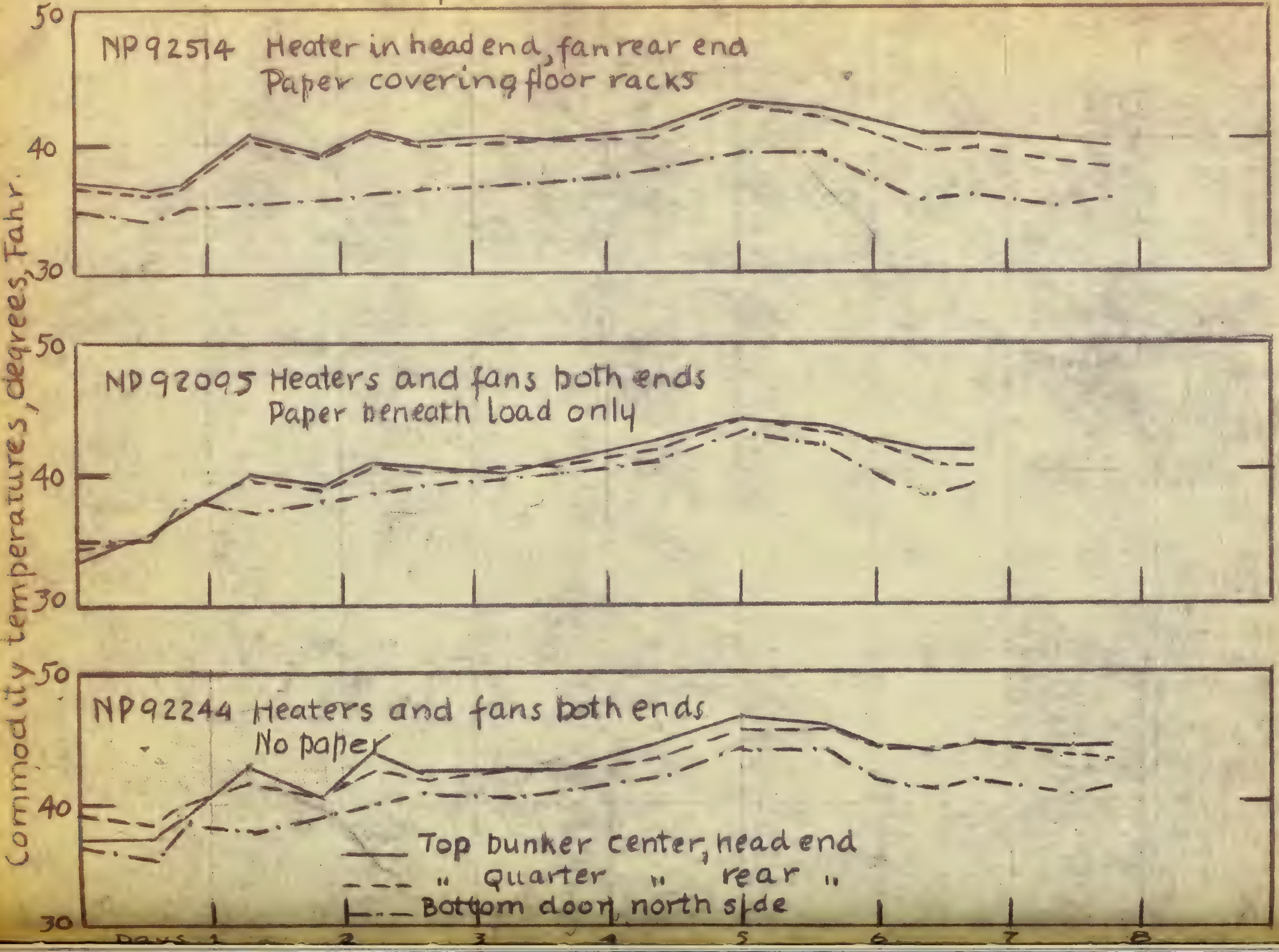


Table 1. · Car Line-Up for Heater Transportation Test (Yakima, Washington to Chicago, Illinois, etc. February 20-27, 1946).

Car		Fan	Kind of	Position of	Floor racks	Drain pipes
Number	Type	Operation	Heater	Heater	papered	plugged
NP 92514	Fan	Rear only	PFE alcohol	Front regular front stand-by	Full width of car	2 north side
NP 92095	Fan	Both ends	PFE alcohol	1 front 1 rear	Width of load only	2 north side
NP 92244	Fan	Both ends	PFE alcohol	1 front 1 rear	None	2 north side
ART 35033	Fan	Both ends	Payne alcohol	1 front 1 rear	None	2 north side
NP 92048	Fan	Both ends	Simplex thermo-charcoal	1 front 1 rear	None	All
NP 90241	Standard	None	PFE alcohol	1 front 1 rear	None	2 north side
NP 90221	Standard	None	Solar alcohol	1 front 1 rear	None	2 north side
NP 90187	Standard	None	Simplex thermo-charcoal	1 front 1 rear	None	All
WFE 65849	Standard	None	WFE alcohol New fan type	1 front 1 rear	None	2 diagonal corners
WFE 65332	Standard	None	WFE alcohol New fan type	1 front 1 rear	None	2 diagonal corners
BRE 74698	Fan	Both ends	Solar alcohol	1 front 1 rear	None	2 north side
BRE 74699	Overhead bunker	None	Under slung Mitchel charcoal	Beneath car 1/	None	All

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1/ Antifreeze solution heated and circulated through pipes beneath floor racks.

Table 2. Car Characteristics

Specifications	NP 92514	NP 92095	NP 92244	ART 35033	NP 92048	NP 90221	NP 90241	NP 90187	WFE 65849	WFE 65332	BRE 74698	BRE 74699
Inside dimensions												
Length	34'6"	34'6"	34'6"	33'2-3/4"	34'6"	34'6"	34'6"	34'6"	33'2"	33'2"	33'2"	39'10"
Width	8'10"	8'10"	8'10"	8'3"	8'10"	8'10"	8'10"	8'10"	8'2"	8'2"	8'3"	8'3"
Height	6'9"	6'9"	6'9"	7'1-1/2"	6'9"	6'9"	6'9"	6'9"	6'10"	6'10"	7'6"	6'10"
Insulation thickness(1)												
Floor	2-1/2"	2-1/2"	2-1/2"	3-5/8"	2-1/2"	2-1/2"	2-1/2"	2-1/2"	2-1/2"	2-1/2"	3-1/2"	3-1/2"
Sides and ends	2"	2"	2"	3-3/4"	2"	1-3/4"	1-3/4"	1-3/4"	2"	2"	3"	3"
Roof	2-1/2"	2-1/2"	2-1/2"	4"	2-1/2"	2-3/4"	2-3/4"	2-3/4"	3"	3"	3-1/2"	3-1/2"
Bulkhead openings												
Top	11"	11"	11"	14"	11"	9-1/2"	9-1/2"	9-1/2"	12"	12"	12"	--
Bottom	6"	6"	6"	7"	6"	13"	13"	13"	12-1/2"	12-1/2"	8"	--
Ice bunkers												
Capacity lbs.	10700	10700	10700	10000	10700	10700	10700	10700	9600	9600	9600	8500
Type	All basket type bunkers											
Loading space												
Cubic feet	2086	2086	2086	1953	2086	2086	2086	2086	1872	1872	2067	2263
Height of floor racks	7-1/2"	7-1/2"	7-1/2"	7-1/2"	7-1/2"	5-1/2"	5-1/2"	5-1/2"	5"	5"	7-1/2"	4-3/4"
Outside roof	All cars metal roof											
Outside siding	Wood	Wood	Wood	Metal	Wood	Wood	Wood	Wood	Wood	Wood	Metal	Metal
Floor rack Stringers(2)	All cars wood											Metal
Side wall racks	None	None	None	1-1/4"	None	None	None	None	None	None	None	None
Air Circulating fans	Preco	Preco	Preco	Preco	Preco	None	None	None	None	None	Preco	None
Door openings	4'	4'	4'	4'	4'	4'	4'	4'	4'	4'	5'	5'
Door fit (Bevel or offset)	Bevel	Bevel	Bevel	Bevel	Bevel	Bevel	Bevel	Bevel	Bevel	Bevel	Offset	Offset

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(1) In addition to insulation thickness shown above, sides and ends of cars NP 92514, NP 92095, NP 92244 and NP 92048 had one course of aluminum foil and roof contained one course of 1/16" wool felt.

(2) All floor rack stringers in standard cars, NP 90241, NP 90221 and 90187 were scalloped.
All floor rack stringers in BRE 74699 were transeverse of car and of open metal type.
Outside floor rack stringers adjacent to side walls in fan cars NP 92514, NP 92095, NP 92244 and NP 92048 were perforated with holes.

Table 3.-Heater Characteristics

Designation	Fuel	Combustion control	Burner	Remarks
PFE	Methyl alcohol	Bi-metallic thermostat on fuel supply (Pilot light)	Asbestos wick	Regular equipment
Payne	Methyl alcohol	Double bellows thermostat on fuel supply (pilot light)	Wick	Test models Removable 5 gal. fuel tanks-Removable burner assembly
Solar	Methyl alcohol	Bi-metallic thermostat on fuel supply (Pilot light)	Pot	Test models, pilot lights of various sizes
FGE 1/ (WFE)	N. propyl alcohol	"Solid-fill" Thermostat on fuel supply (Pilot light)	Wick	Test models-Fitted with hot-air engine to blow heat beneath floor racks
Simplex	Charcoal	Bellows Thermostat on draft	Grate	Manual ignition
Mitchell	Charcoal	Manual draft control	Grate	Manual ignition. Permanently installed beneath car, heating anti-freeze solution for circulation in pipes beneath floor racks

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1/ FGE (WFE)/heaters were placed on ice pans. All other were on ice grates

Table 4.-Loading Data

Type of Observation	Car Number											
	NP92514	NP92095	NP92244	ART35033	NP92048	NP90241	NP90221	NP90187	WFE 65849	WFE 65332	BRE74698	BRE 74699
Shipper	Lamb Fruit Co.	Yakima County Hort. Union	Sundquist Frt. &Cold Stg. Co.	Yakima Fruit Growers Assn.	Yakima Fruit Growers Assn.	Yakima County Hort. Union	Yakima County Hort. Union	Pacific Frt. & Produce Co.	Perham Frt. Co.	Sundquist Frt. & Cold Stg. Co.	Wash. Frt. & Produce Co.	Richey Gilbert & Co.
Loading Point	Gleed	Yakima	Yakima	Weikel	Weikel	Naches	Naches	Yakima	Grandview	Yakima	Yakima	Yakima
Destination	Detroit, Mich	Milwaukee	New York	New York	Chicago	Chicago	Chicago	Minneapolis	Chicago	Chicago	Chicago	Chicago
Date Loaded	2/19/46	2/18/46	2/19/46	2/19/46	2/19/46	2/19/46	2/19/46	2/18/46	2/19/46	2/19/46	2/18/46	2/18/46
Start (Temp.)	9:00 a.m. 33°	3:00 pm 44°	10:00 am 44°	8:35 am 36°	11:50 am 40°	11:15 am 45°	9:30 am 3[illegible]°	8:15 am 33°	10:15 am 40°	7:45 am 41°	1:15 pm 42°	1:45 pm 42°
Finish (Temp.)	12:00 m. 37°	5:00 pm 43°	12:00 N. 55°	11:30 am 40°	2:55 pm 42°	2:00 pm 49°	11:00 am 44°	11:30 am 39°	1:25 pm 54°	9:36 am 43°	3:30 pm 44°	3:15 pm 45°
Fruit temps.	32°	33°-35° Avg. 34	34-39° Avg. 36°	30°	30-32° Avg. 31°	32-50° Avg. 34°	33-35° Avg. 34°	32-34° Avg. 33°	31-36° Avg. 33°	35-37° Avg. 36°	32-33° Avg. 33°	32-36° Avg. 34°
Kind of Fruit	Delicious	Winesap	Delicious	Delicious	Delicious	Winesap	Winesap	Delicious Winesap	Red Delicious	Delicious	Delicious	Delicious Winesap
Billed Wt. lbs.	41097	41097	41097	41097	41097	41097	41097	42640	41097	41097	41097	41097
Number boxes	798	798	798	798	798	798	798	800-60/24# [1]	798	798	798	798
Load description	Solid, tight	Solid, tight	Solid, tight	Solid, tight	Solid, tight	Solid, tight	Solid, tight	Solid, tight	Solid, tight	Solid, slack	Solid, tight	Solid, tight
Stacks, rows and layers [2]	9-7-6 A 12-7-5	9-7-6 A 12-7-5	9-7-6 12-7-5	13-7-6 6-7-5 2-7-3	16-8-5 5-8-4	9-7-6 12-7-5	9-7-6 12-7-5	16-8-5 5-8-4	13-7-6 6-7-5 2-7-3	14-7-6 6-7-5	14-7-6 6-7-5	18-7-5 5-7-4 2-7-2
Height of stacks inches	73 61	73 61	73 60	73 59-61	62 49-51	73 61	73 61	61 57	72 43-61	73 61	73 61	61 49-39
Ceiling space inches [3]	6 18	6 18	6 18	12 26-24	19 31	8 20	8 20	20 24	9 39-21	8 21	17 30	21 53-43
Side-wall space inches	4 to 5 [3]	8 to 10	10 to 11	5-6 to racks	4 to 5	4-1/2 to 7	3 to 9-1/2	2 to 3	6 staggered	6 to 7	6 to 7	4 to 5
Layers, stripped	2nd, 4th, top	2nd, 4th, top	3rd, top	1st, 3d, 4th, top	1st, 3d. top	3rd, top	3rd, top	top only	top only	3rd, top	3rd, top	3rd, top

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[1] Car NP 90187 had 60 small 24 lb. boxes on top of the 4-layer stacks at the doorway. These were not tightly loaded and were subject to shifting.

[2] Car NP 92095 was loaded 6 layers high in the A (forward) end and 5 layers high in the B (rear) end.
Car NP 92514 was loaded 6 layers high in the A (rear) end and 5 layers high in the B (forward) end.
Cars ART 35033 and WFE 65849 each had two stacks at doorway on end, 3-high.
Car BRE 74699 had 2 stacks at doorway on end, 2-high.
Car NP 92048 had 2 stacks with 7 rows of boxes in the top layer.
Car WFE 65332 had 4 inches of slack space between stacks meeting at doorway, not taken up with bracing. Layers in joining stack were staggered over open spaces and lath was nailed lengthwise on top layer. Load was subject to shifting lengthwise.
Car BRE 74698 had 4 inches of slack space between stacks meeting at doorway taken up by two 2x4's crosswise on each staggered layer.

[3] Car NP 92514 had rows spaced about 2 inches apart, leaving less space between load and side-walls than in comparable cars loaded 7 rows wide.

Table 5.-Comparison of readings obtained with Liquidometers and Electric Resistance Thermometers

Station	Reading	Fan Car BREX 74698			Overhead Bunker Car BREX 74699		
		Liquidometer		Elec. Res. Therm.	Liquidometer		Elec. Res. Therm.[1]
		Top	Bottom	Bottom	Top	Bottom	Bottom
Yakima	Feb. 20 1:15 pm	42.5	35.5	34.5	36.5	34.5	33
Pasco	Feb. 20 7:30 pm	49	40	37.5	42	35	33
Pasco	Feb. 21 7:45 am	44	38	36	37.5	35	33
Lamont	Feb. 21 8:30 pm	54.5	43.5	41	40	36	33.5
Yardley	Feb. 22 6:00 am	45	41	38	38	36	33.5
Paradise	Feb. 22 2:45 pm	46	43	40	40	36	35.5
Helena	Feb. 23 6:00 am	43	43	40	36	36	34.5
Livingston	Feb. 23 2:50 pm	46	44	41.5	38	36	35
Forsyth	Feb. 24 8:30 am	44	44	41.5	37	36	35
Dickinson	Feb. 25 12:50 am	48	46	44	42	38	38
Jamestown	Feb. 25 3:00 pm	46	46	43.5	37	36	35.5
Dilworth	Feb. 25 11:00 pm	42.5	44.5	42	34.5	32	33
Staples	Feb. 26 10:15 am	42	44	41	34	30	30.5
Northtown	Feb. 26 7:00 pm	40	44	42	34	34	34
N. Lacrosse	Feb. 27 10:30 am	41	44	41	32.5	31	32.5
Savanna	Feb. 27 7:00 pm	42	42	43	35	34	36

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[1] Electric resistance thermometer in this car was 18 inches from Liquidometer bulb and was above the floor rack.